

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 1 094 030 A3**

(12)

**EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
02.05.2002 Bulletin 2002/18

(43) Date of publication A2:  
25.04.2001 Bulletin 2001/17

(51) Int Cl.7: **C01B 3/38, C01B 3/32,  
C01B 3/48, B01J 8/04,  
C01B 3/40, C01B 3/50,  
C01B 13/02**

(21) Application number: 00122651.3

(22) Date of filing: 18.10.2000

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

(30) Priority: 20.10.1999 JP 29794599  
03.03.2000 JP 2000058483

(71) Applicant: **NIPPON CHEMICAL PLANT  
CONSULTANT CO., LTD.  
Chiyoda-ku Tokyo (JP)**

(72) Inventor: **Maruko, Saburo  
Yamato-shi, Kanagawa (JP)**

(74) Representative: **Fuchs Mehler Weiss & Fritzsche  
Patentanwälte  
Postfach 46 60  
65036 Wiesbaden (DE)**

**(54) Reforming method and apparatus for hydrogen production**

(57) An auto-oxidation and internal heating type reforming method and apparatus for hydrogen production are disclosed for use in a process in which a gaseous mixture of a hydrocarbon or an aliphatic alcohol with water vapor is fed (21) into contact with a mass of a reforming catalyst to bring about a reforming reaction of the gaseous mixture to produce hydrogen, wherein a small amount of an oxidizing catalyst is admixed with the re-

forming catalyst in that mass (52); and a small amount of oxygen is admixed with the gaseous mixture, whereby a portion of the hydrocarbon or aliphatic alcohol is exothermally oxidized to generate a quantity of heat required to reform the gaseous mixture of the hydrocarbon or aliphatic alcohol with water vapor.

**EP 1 094 030 A3**



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 00 12 2651

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL.7)
X	WO 96 00186 A (JOHNSON MATTHEY PLC ; PIGNON JOHN FREDERICK (GB); EDWARDS NEIL (GB)) 4 January 1996 (1996-01-04) * claim 1; example 4 *	1,2,5	C01B3/38 C01B3/32 C01B3/48 B01J8/04 C01B3/40 C01B3/50 C01B13/02
X	US 5 112 578 A (MURAYAMA KATSUTOSHI ET AL) 12 May 1992 (1992-05-12) * claim 1; figure 1 *	1,3,5	
Y	IDEM	8,10-12	
A	IDEM	13	
X	DE 44 23 587 A (DAIMLER BENZ AG) 11 January 1996 (1996-01-11) * claim 1; figures * * column 2, line 8 - line 22 * * column 2, line 53 - line 66 *	1,2,5,9	
X	TAKI M ET AL: "HIGH EFFICIENT AND COMPACT METHANOL REFORMER FOR FUEL CELLS" TOYOTA TECHNICAL REVIEW, TOYOTA, JP, vol. 47, no. 2, November 1997 (1997-11), pages 76-81, XP002926587 ISSN: 0916-7501 * abstract *	1,5	TECHNICAL FIELDS SEARCHED (InCL.7)  C01B B01J
X	WO 99 48805 A (CARPENTER IAN WILLIAM ; JOHNSON MATTHEY PLC (GB); HAYES JOHN WILLIA) 30 September 1999 (1999-09-30) * page 4, line 23 - line 26 * * claim 1; example 2 *	1,2,5	
-/-			
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>8 March 2002</b>	Examiner <b>Van der Poel, W</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons  & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (06/00)



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 00 12 2651

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 382 (C-535), 12 October 1988 (1988-10-12) & JP 63 129002 A (HITACHI LTD), 1 June 1988 (1988-06-01) * abstract *	1,2	
Y	IDEM	11	
Y	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 03, 31 March 1997 (1997-03-31) & JP 08 301601 A (ISHIKAWAJIMA HARIMA HEAVY IND CO LTD), 19 November 1996 (1996-11-19) * abstract *	8,10,12	
A	WO 98 08771 A (LITTLE INC A) 5 March 1998 (1998-03-05) * figure 1 *	13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 March 2002	Examiner Van der Poel, W
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document</p> <p>T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date O: document cited in the application L: document cited for other reasons &amp;: member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.02 (P04/01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 12 2651

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-03-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9600186 A	04-01-1996	AT 174871 T	15-01-1999
		AU 683760 B2	20-11-1997
		AU 2749295 A	19-01-1996
		CA 2193115 A1	04-01-1996
		DE 69506869 D1	04-02-1999
		DE 69506869 T2	02-06-1999
		DK 766643 T3	23-08-1999
		EP 0766643 A1	09-04-1997
		ES 2126292 T3	16-03-1999
		WO 9600186 A1	04-01-1996
		JP 10502047 T	24-02-1998
		US 5762658 A	09-06-1998
US 5112578 A	12-05-1992	JP 1261201 A	18-10-1989
		AU 613175 B2	25-07-1991
		AU 3276789 A	19-10-1989
		CA 1328558 A1	19-04-1994
		DE 3912003 A1	26-10-1989
		GB 2222096 A ,B	28-02-1990
DE 4423587 A	11-01-1996	DE 4423587 A1	11-01-1996
WO 9948805 A	30-09-1999	AU 3042399 A	18-10-1999
		EP 1068148 A1	17-01-2001
		WO 9948805 A1	30-09-1999
JP 63129002 A	01-06-1988	NONE	
JP 08301601 A	19-11-1996	NONE	
WO 9808771 A	05-03-1998	US 6126908 A	03-10-2000
		AT 203490 T	15-08-2001
		AU 729890 B2	15-02-2001
		AU 4161097 A	19-03-1998
		CN 1228749 A	15-09-1999
		DE 69705844 D1	30-08-2001
		EP 1118583 A2	25-07-2001
		EP 0922011 A2	16-06-1999
		ES 2159146 T3	16-09-2001
		JP 2000516902 T	19-12-2000
		WO 9808771 A2	05-03-1998
		US 6083425 A	04-07-2000
		US 6207122 B1	27-03-2001
		US 6123913 A	26-09-2000
		US 6254839 B1	03-07-2001
		US 2001009653 A1	26-07-2001

EPO FORM P419

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82